Interface on the skin

Designing through a user centered approach

Appendix

Appendix A

Clustered context factors concerning the development of interactions and technology

People are overwhelmed by today's amount of impulses

The news shows all negative things that happen in the world.
It is expected to receive a response to a text almost immediately
Every product needs to be interesting and fun.
More (young) people get burnouts/are depressed.
Overwhelmed by the world (too much information and opinions)
People create an aversion to social media

Technology empowers people to be more independent

Self sustainable houses through having own energy supply and waste processing
Technological devices become more intuitive and easy to use.
Smart TV's give the user more control in which content to watch. (Compared to conventional TV)
2nd hand is more accessible through the internet.
More control in life because of constant (health) checking
Easier access to workshops for self improvement.
Advancing technology makes traveling cheaper
People are able to work more flexible
People are enabled to earn money through airbnb and uber.
The rise of crypto money
People check for the lowest price of a product online
Technology can monitor the body and respond to measured data.
The internet makes it possible to organize big protests
Every product is rated and reviewed online.
People are more health conscious due to access to online information on the topic
More people tend towards a healthy lifestyle
It is difficult for politicians to control the public opinion because of open access to internet.
Products can be 'seen' in your house before you buy them using AR.

People live relatively more in the digital world

Children play more with technology and less outside
Parents are sometimes neglecting their kids because of technological distraction
Social media is causing a lot of distraction
Apps that provide basic human needs are very popular.
Games use small rewards to keep people playing them
People become addicted to social media
Instead of learning from family, we find all our recipes online
People are less social in public spaces with the people around them.
Sharing every moment of your life with the world
Quality time with family is more scarce

Technology helps improving humanity

Technology helps growing more food in a more efficient way
Advanced weaponry cancels out human risk at the side that owns this technology
Technology helps our houses being safer
Technology helps bored/lonely elderly with their problems
Technology in the kitchen makes it easier for us to cook meals
Technology can stimulate people to move more
Measuring data and better training methods allows for increasing sports achievements
Technology can help to clean up the oceans
A lot of writings are produced digitally which prevents paper waste.
Technology helps to create clean energy
Smart lights reduce energy consumption
People in western counties become relatively older.
Vehicles are able to drive themselves
Teaching has become more interactive. Watching videos alone and discussing it together. Time better used.
Memory and processing power increase rapidly, allowing for more advanced devices.
Houses become smart.
Technology is able to hear and understand languages, and respond to it.
Cleaning up the ocean using technology

A human response to technology

People do yoga and mindfulness to relax
People do not want to be rude by checking messages while in a conversation
Social media retreat: where people spend a week without social media or phone
Supermarkets start to look like market squares
More cities try to ban dirty cars by implementing 'environmental zones'

The shape of jobs and products are changing

Influencers determine what we buy
Ordering food and products to your house is easy through the internet.
Fear of losing job to technology
Hacks are a new way of attacking another country
Schools become more digital, using smart-boards and apps as assisting tools
People order more and more online
More and more jobs involve IT related tasks
Wearable technology becomes more accepted (earpods, smart watches)
Sharing products becomes more common
Possible to pay with phone within a second
Working spaces become modular.
Many children are not able to read the time on an analog clock anymore
People now check out themselves at the supermarket
Robots take over a lot of (easy) jobs
online contact between customer and company more often happens through scripted chat bots

Technology is causing global environmental problems

Every year there are more traffic jams due to the increase of cars.
Technological waste is difficult to process
More people have access to electricity which increases the usage of it
Advanced technology requires expensive natural recourses.
Healthier people is causing the world population to increase
Sitting is the new smoking
It is difficult to make rules and regulations on technology since their development goes very quick.

The world is becoming smaller and people's lives are more connected

Politicians cannot have private lives anymore
People become more aware of 'the world' and want to explore it.
Google earth allows you to see every street in the world
Apps can tell precise locations of deliveries, airplanes and people.
It is difficult to function in todays world without speaking English.
Video-calling allows for seeing relatives that are far away
People need to be tolerant to more different kinds of people
Too many high educated people.
Population growth in a country is a result from immigration
Awareness of global warming is becoming more widely spread
There is more and more awareness of humans exhausting the earth
Feel more emotional connection to celebrities through social media
Being able to find information on anyone
Privacy is almost not existing anymore.

There is more influence of others on your way of living and your thoughts

Opinions can be biased through algorithms in social media.
In some countries the government can control social media
Only positive aspects of life are highlighted in social media
Your popularity is displayed in the amount of followers you have.
Small amount of likes give people low self image.
Every special occasion/object needs to be filmed/photographed
People gain self esteem through apps as instagram
People are excluded from certain services (banking) when they don't have internet.
Technological companies are the biggest in the world and have a lot of influence on policies
A lot of food contains a lot of modifications

People are more polarized in their opinions

Everyone can give their unsalted opinion online without experiencing social consequences.
Social judgment is much more present with the rise of the internet
Politicians are more polarized in their way of speeching
In many cultures, expensive products count as status symbols.

People are becoming less responsible and more dependent.
People have less financial sense since it is not tangible anymore
People have less geographical knowledge but determine on their phone to
bring them somewhere
Agenda's are completely digital
People are more aimed at instant satisfaction
People throw away stuff very easily where in the past waste didn't exist.
The prices of new phones are for many people very expensive
Many technological products can be paid in monthly terms.

Appendix B

A brainstorm and clustering of characteristics that come with the design analogy

Functional needs

Duval et. al. (2010) discovered that people are strongly attracted to wearables offering one of the two primal needs from the hierarchy of needs (Maslow)

- A clear goal (becoming healthy, gaining self-esteem etc)

Social aspects

Other factors that might influence acceptance such as social or cultural influences, or privacy related matters

- External motivating people

- The professionalism (Are you convinced he knows what he is doing?)

- Your personal relation with this trainer (Is he friendly, helpful, supportive etc)

- The house rules of the gym (the culture of the gym)

Physical aspects

Does the wearable look appealing? Is it comfortable? Is it safe? All aspects in relation to the physical properties of the product

- The type of people that are around you in the gym (are you comfortable, or are you being judged)

- External facilities (showers, changing rooms etc)

- The atmosphere of that gym (Does the equipment look nice, is there airco etc.)

Cognitive attitude

This describes the user's attitude towards the new technology in terms of perceived usefulness and ease of use

- Your knowledge on the equipment and how it works (ease of use)

- Seeing improvement (more reps or better body) (usefulness)

- The capability of the trainer to motivate you (ease of use)

Demographic characteristics

Age, sex etc that influence the adaptation of the wearable

- Accessibility of the gym

- It should be within your price range

Experience with the topic

Experience with similar products

- Your knowledge or recommendations on which gym (and personal trainer) to go to (If you do not have any knowledge on this topic, the threshold to start searching and eventually go to a gym is much higher)

Appendix C
Summaries material research report

Sensory overview

Name	Image	Principle	Location of appliance	Extent/ability to build at TU Delft	Deforming to the body shape	Comfort on body	Stretchability (up to 32%)	Customizability of design	Total, cumulative score	Additional advantages	Additional disadvantages	Applications mentioned in the paper
Weight factor				5	4	3	2	1				
ISkin		Measures the severity of touch through capacitive and resistive sensing	Body (general)	3	3	2	3	3	42	• Design shapes can be customly made. • Allows also for circular and linear movement detection. • The electrodes can be close to each other (to 1mm) which allows for a thin device	• The sensor needs to be calibrated when placed on the skin every time, in order to recognize signals. • After stretching it takes some hours for the material to reach its normal resitance again.	• A finger strap for one hand controls. • An extending input face for wearables. • Control music from your arm.
Stretchis		Measures touch and proximity through capacitive sensing	Body (general)	3	3	2	3	3	42	• Can sense touch and proximity. • Can sense and provide EL light at the same time. • Device keeps working under strain.	• The device has a breaking point at 153% stretch, and does not start working again when placed in a relaxed state. • The device is not capable of sensing strain.	• Device can be used as a music control panel on the skin. • Able to send discreet messages when applied in clothing.
Electrodermis		Type of sensing depends on which sensor is installed on the patch	Body (especially joints)	3	3	3	3	2	40	• No chemicals are used in the design process. • Lasercutting makes mass production more available. • Layers stick to eachother without glue, since they are heat sensitive. • Can be placed on difficult body areas such as joints.	• Designing the shape of the patch is difficult and requires some experience. • The bandage is not waterproof . • The parts on the bandage that contain components are not flexible.	• It has multiple sensory uses (depending on which components are placed on the bandage)
Skinmarks		Measures touch, squeezing and bending through capacitive and resistive sensing	Body (specific landmarks)	3	3	2	2	1	38	• Easy to be placed on the right spot of the body. • Using body landmarks make it easier to find-, and interact with the tattoo.	• The sensor could be damaged quicker since it is placed on locations on the body that bend a lot. (knuckles, fingers) • The sensor is sensitive to unintentional input.	
Skintillates		Measures touch and bending through capacitive and resistive sensing	Body (general)	3	3	2	1	3	38	• It complements already existing tattoos	• Taking off the tattoo needs to be done carefully since the tattoo is very vulnerable. • There is a weak signal between tattoo and components, which results in lower sensitivity of the tattoo.	• A tattoo that controls things in your house • Can be used as a turning signal for motorcyclists
Duoskin		Measures touch through capacitive sensing	Body (general)	3	3	2	1	3	38	• Easy to attach and remove • Robust to movement and deformations do not damage the device. • The device has aesthetic colors • Different colors can be printed on top of the gold • The device has a high accuracy.	• When using the thermochromic variant, the conductive gold leaf layer becomes hot.	• Can be used as an accessoire. • Could function as a NFC antenna. • Can be used to sense touch.
Hydrogel touch		Measures the location of a touchpoint through resistive sensing	Body (general)	2	3	2	3	1	35	• Can measure the location of touch input on a surface. • Consists of stretchable material.	• Cannot sense well on difficult shaped surfaces.	• Can be used to determine the location of touch
Multitouch skin		Measures touch through capacitive sensing	Body (general)	3	2	2	1	1	33	• Custom shapes of the device can be designed. • A shield layer protects the signal from noise caused by the skin. • The sensor still shows high accuarcy when bended and/or scaled. • It can sense multiple touchpoints at once.	• Not known how many repitions of bending the sensor can take. • When folding sharp, sensing functions disable in the fold itself. • The amount of rows and columns depend on the amount of input ports on the microcontroller. • Half shaped electrodes are not possible, causing some parts of design not to be covered.	• Used as a controlling device when placed on the forearm. • Worn as a bracelet since it can sense swiping movement. • Placement behind the ear to control earphones. • On the inner hand to enable one hand controls.
Jacquard		Measures touch through capacitive sensing	Clothing	1	3	3	2	3	33	• Is inexpensive and can be made with existing weaving equipment. • The yarn is strong. • The yarn can be made in different colors. • Can look and feel like other materials.	• Textile can not be applied on a big surface, since every wire has to be connected seperately to an input on the microcontroller, which only has a limited amount of inputs.	
Self-healing tattoo		Measures humidity, temperature and strain through resistive sensing	Body (general)	1	3	3	2	2	32	• The tattoo is self healing by applying water • No irritation on the skin after use. • Shows high sensitivity and a fast response time.	• The tattoo is black. • When a waterproof layer is added, it loses its capability to sense humidity.	• Can measure respiration when placed under the nose • Sense the temperature of water that touches the skin
NailO		Measures touch through capacitive sensing	Body (nail)	2	1	3	1	1	26	• The device is small and subtle. • Easily removable. • High touch and swipe accuarcy. • An additional aesthetic layer can be added. • Supports one hand usage.	• Moving on the nail is sometimes hard since the nail is not flat. • Difficult to reach the thumb nail with small fingers. • Different sensor sizes are needed depending on people's nail size.	• Interface controlling when the hands are full. • Subtle interactions which are barely visible for others. • It can be used to expand the input surface of existing devices such as smartwatches.

Actuator overview

Name	Image	Principle	Type(s) of actuator	Extent/ability to build at TU Delft	Deforming to the body shape	Comfort on body	Stretchability (up to 32%)	Customizability of design	Total, cumulative score	Additional advantages	Additional disadvantages	Applications mentioned in the paper
Weight factor				5	4	3	2	1				
Tacttoo		Small current appliance	Augments tactile expressions on the skin	3	3	3	3	2	44	• User can feel other textures through the tattoo. • Provides tactile signals to the user through small current. • Safe device because only a small current is used.	• Incorrent contact can damage the electrode. • Resistance in device increases over time which means higher voltages are needed. • The minimum distance between electrodes is 0,5mm. (Some nerves on for example the finger will not receive input from electrode)	• Tactile feedback i.c.w. AR can be created. • Providing tactile feedback on paper prototypes. • Tactile feedback in VR. • Receiving discreet notifications.
Stretchis		Stretchable electroluminescense	Emits light	3	3	2	3	3	42	• Can sense touch and proximity. • Can sense touch and provide electroluminescent light at the same time. • Device keeps emitting light under strain. • The light emits in two directions	• The device stops working at 153% stretch, and does not work anymore when put in a relaxed state. • The device is not capable of sensing strain.	• Device can be used as a music control panel on the skin. • The material could be applied in clothing.
AnimSkin		Thermochromic powder	Changes color	3	3	2	3	3	42	• The electrode can also be used for capacitive sensing. • The heat generated by the tattoo is sensed, but not indicated as causing discomfort.	• The tattoo would change color if the air temperature reaches 38 degrees celsius or higher.	• It can mimic a breathing pattern on the skin. • It can augment moving shapes on the body. • It can display a progress bar on the skin. • Shapes can change their form on the skin.
Coplanar EL device		(Stretchable) electroluminescense	Emits light	3	2	2	3	3	38	• The electrodes do not need to be transparent. • Dielectric and phosphor layer can be applied using machinery. • Emits the same amount of light as a conventional EL device. • Light only occurs where a conductor is applied. • The gap between electrodes can be small (0,4mm)	• When machinery techniques are used in production, leakage of current can occur in the device. • It is not tested how well the coplanar EL device works in a stretchable variant.	• Drawing with lights, using graphite material as conductor. • Can be placed on an umbrella to light up when it rains. • Helps to visualise the different states of a liquid.
Strain color change		Light emittance using fluorophores	Changes transparency/color	3	3	1	3	2	38	• Works without power source • No change in light emittance after a lot of stretching cycles.	• In production, a thin layer of material needs to be removed which could be tricky to do. • There is always strain required to activate color change.	• Hiding/showing text. • Changing the color of a product. • Make a hidden message appear.
Springlets		Contraction of SMA	Gives tactile feedback to the user	3	3	1	1	3	35	• It is a silent device. • The skin is protected from the produced heat needed to activate the SMA. • The device can be worn for a long time before it starts to get loose (around 5 days)	• Can be painfull due to pulling of bodyhair. • Bodyhair can also prevent good adhesion to the skin. • It is difficult to control the temperature of the SMA preciely. • SMA's are not energy efficient due to heat generation.	• Receiving message from a loved one behind your ear. • Can be used as navigation. • Can receive tactile signals while using VR.
Electrochromic color change		Voltage sensitive materials	Changes color	2	3	2	2	3	35	• The possibility to change color without deformation of the material. • The device is very sensitive and therefore requires just a small voltage to change color.	• At 10% strain, the resistance of the material is already really high. • Therefore high strain will not result in new/more color change.	• Camouflage
Frozen suit		Particle jamming	Force blockage of joints	3	2	2	1	1	32	• Causes stiffness around predetermined joints. • Supports directional flexibility.	• It is, compared to the other devices, a thick device. • Patches become less stiff over time due to gravity and movement.	• Can help to achieve the right posture. • Can simulate an injury in military training. • It can prevent certain movements in rehabilitation.
Skin+		Controlled fluid flow	Shape change on body	2	2	2	2	3	31	• Can transport fluids over the body. • When empty, the tattoo is transparent. • Liquid can also send a signal to the wearer through tactile sensations. (Using cold or warm liquids)	• It is unknown how fast the tattoos damage. • The liquid needs to be stored somewhere when it is not in the tattoo.	• Display information on the body. • Liquid can flow over the body in a determined velocity. • It can be used to cool the body. • Can transport a drug to a desired area on the body.
Textile display		Electroluminescent fiber	Emits light	1	2	3	2	2	28	• Stretch cycles do not affect the brightness of the fiber. • The device works in liquids as well. • Twisting the fiber does not affect the brightness. • Temperature of fiber stays relatively low (24 degrees celsius)	• Can get damaged over time by wear. • The fiber is difficult to make yourself.	• Making light emitting paterns on textile.

Appendix D

Answers gained from contextual user test, sorted per participant per question

Context: Festival

Participant	Gender	age	has tattoos	perception of other peoples tattoos
1	Woman	25	no	Tattoos have become more common
2	man	26	no	Cool on arms or legs. Face too intense
3	Woman	24	no	Should not be too crazy. Some are pretty.
4	woman	23	no	No particular opinion. Small is nice. Some can look agressive
5	Woman	23	no	not a particular opinion
6	Man	25	no	Cool and unique. On the face is too extreme.
7	Man	27	no	Depends if it fits with the person. Then it could be cool
8	Man	26	yes	Nice, but should have a meaning
9	Woman	26	no	Something small is nice
10	Woman	24	no	If it is not on the face it is nice.

Participant	First impression of the new tattoo concept	Which Purpose	How would it look
1	Would be interested in a tattoo that you can interact with	identity + connectivity to part of festival)	line drawing/not too classic
2	Very cool, if it is not too expensive	identity + connectivity to part of festival)	like a map
3	Sounds futuristic. Interesting if not permanent.	identity (to look good)	beautifl and funny
4	Sounds cool, especially when temporary	connectivity	symbolic (represents the group)
5	nice if it is temporary	identity + connectivity to part of festival)	abstracts that fits with the event
6	Sounds cool, but difficult. Something I cannot take off like a festival bracelet i dont like.	identity (which band/genre)	style fits with theme
7	Yes if you can customize the design it could be cool	identity + connectivity to part of festival)	something that fits with your gen
8	Would like to try it and see how it works	connectivity	an emblem that connects you to
9	Interesting and cool that it is something that does not exist yet.	identity	depends on your clothes style
10	thinks it is interesting	connectivity	abstract with lines

Context: Festival

Participant	Where on the body	Size	Who wears it	Who interacts with it
1	where there is no clothes	big	everyone(when entering)	others, when you accept them
2	under arm	big	small group	yourself, to set to which stage you go
3	shoulder/upper arm	big	a few to stay unique	others, when you accept them
4	underarm	small	diferent per tattoo	yourself
5	shoulder/arm	medium	a specific group	yourself
6	shoulder	big	you or a few (but different look of tattoo)	yourself
7	under arm	big, man	yourself	yourself
8	hand	medium	everyone(when entering)	yourself
9	arm, shoulder	big	yourself	yourself
10	hand arm	medium	everyone(when entering)	everyone

Participant	Which interaction types and movements	Does interaction work in this context?
1	swipe and light up where you swiped over lines	-
2	tap to turn on the stage you'll go to on the map-tattoo	-
3	Hold or circle(to prevent exidents) something flashy that draws attention	-
4	interaction that is enhanced when executed with the group.	-
5	hold/circle, turn on and off light of tattoo	-
6	tap to turn tattoo on and off	-
7	tap to start pulsing	-
8	a flashy response, tap interaction to turn on.	-
9	change color when outfit changes at event. Tap.	-
10	High five with people with same tattoo type. both light up one long pulse.	-

Context: Hostel

Participant	Gender	age	has tattoos	perception of other peoples tattoos
1	Woman	25	no	Tattoos have become more common
2	man	26	no	Cool on arms or legs. Face too intense
3	Woman	24	no	Should not be too crazy. Some are pretty.
4	woman	23	no	No particular opinion. Small is nice. Some can look agressive
5	Woman	23	no	not a particular opinion
6	Man	25	no	Cool and unique. On the face is too extreme.
7	Man	27	no	Depends if it fits with the person. Then it could be cool
8	Man	26	yes	Nice, but should have a meaning
9	Woman	26	no	Something small is nice
10	Woman	24	no	If it is not on the face it is nice.

Participant	First impression of the new tattoo concept	Which Purpose	How would it look
1	Would be interested in a tattoo that you can interact with	interest + identity	depends on person
2	Very cool, if it is not too expensive	connectivity (doing certain activities)	like a game. a row of squares
3	Sounds futuristic. Interesting if not permanent.	interest + identity	something with a lot of meaning
4	Sounds cool, especially when temporary	interests	depends on persons interest
5	nice if it is temporary	connectivity	emblem that fits context
6	Sounds cool, but difficult. Something I cannot take off like a festival bracelet i dont like.	emotions	subtle. (small circle)
7	Yes if you can customize the design it could be cool	emotions	subtle, like stars maybe
8	Would like to try it and see how it works	interests	something that represents what you like
9	Interesting and cool that it is something that does not exist yet.	interest + identity	Choosing from a range offered by hostel
10	thinks it is interesting	interests	Depends on your interests

Context: Hostel

Participant	Where on the body	Size	Who wears it	Who interacts with it
1	arms/hands	medium	1 person	you, or others if you show them
2	underarm	medium	a few. you can join if you want	you, or others if you show them
3	inside under arm	small	1 person	yourself
4	under arm	small	a group. Everyone who wants can join	you, or others if you show them
5	arm	medium	multiple people	yourself
6	hand/inner under arm	small	1 person, max 3	yourself
7	arm	medium	1 person	yourself
8	under arm	big	1 person	you, or others if you show them
9	arm or hand	medium	people who want to find people to do stuff with	yourself
10	inner under arm	small	1 person	you, or others if you show them

Participant	Which interaction types and movements	Does interaction work in this context?	
1	colour change. tap or hold. colorize tattoo	-	
2	Game element. something unexpected/revealing. Circle/tap	-	
3	multiple interactions and responses, so you can show others	-	
4	pulsing for attention with tap. circle to change shape of tattoo. (like scrolling)	-	
5	Turn on when you want contact. tap to light up	-	
6	simple tap/on off light. Showing the tattoo to others	no, if it is not functional in this context	
7	tap to change color of stars. Some light up to catch attention	-	
8	It could light up if you would like to meet someone that is also interested in the same. tap	-	
9	Turn tattoo to black when you don't want to be bothered	-	
10	Double tap. Tap is too easy. Reveals more about the interests. Image change/colorisation.	-	

Context: Housewarming

Participant	Gender	age	has tattoos	perception of other peoples tattoos
1	Woman	25	no	Tattoos have become more common
2	man	26	no	Cool on arms or legs. Face too intense
3	Woman	24	no	Should not be too crazy. Some are pretty.
4	woman	23	no	No particular opinion. Small is nice. Some can look agressive
5	Woman	23	no	not a particular opinion
6	Man	25	no	Cool and unique. On the face is too extreme.
7	Man	27	no	Depends if it fits with the person. Then it could be cool
8	Man	26	yes	Nice, but should have a meaning
9	Woman	26	no	Something small is nice
10	Woman	24	no	If it is not on the face it is nice.

Participant	First impression of the new tattoo concept	Which Purpose	How would it look
1	Would be interested in a tattoo that you can interact with	showing emotions	depends on person
2	Very cool, if it is not too expensive	interest + identity	helps the user. e.g. reminder to play guitar
3	Sounds futuristic. Interesting if not permanent.	identity (i like gadgets)	beautiful and funny
4	Sounds cool, especially when temporary	show interests	depends on theme and user
5	nice if it is temporary	-	-
6	Sounds cool, but difficult. Something I cannot take off like a festival bracelet i dont like.	showing emotions	simple circle shape
7	Yes if you can customize the design it could be cool	Show emotions	Like stars on your arm
8	Would like to try it and see how it works	interest (of gadget)	something abstract with lines
9	Interesting and cool that it is something that does not exist yet.	identity	Funny, showing your favourite drink
10	thinks it is interesting	interest (of gadget)	Simple shape

Context: Housewarming

Participant	Where on the body	Size	Who wears it	Who interacts with it	Which interaction types and movements
1	arm	medium	yourself	Yourself	As many different interactions and responses
2	under arm	medium	yourself	yourself	swipe to turn on/off or change color, explain meaning to others
3	under arm	small	1 or max 2	yourself, or others when you show them	simple interaction and subtle response
4	under arm	small	yourself	others	tap to turn on and off pulse
5	-	-	-	-	-
6	inside of wrist	small	yourself	yourself, or others when you show them	light up that follows circle movement of the finger.
7	arm	medium	yourself	yourself	more taps turns on different stars with different colors.
8	under arm	big	yourself	yourself, or others when you show them	Tapping on different surfaces turns them on. Different surfaces
9	wrist	small	yourself	yourself, or others when you show them	simple tap, starts blinking when youre holding a drink.
10	arm	medium	yourself	yourself, or others when you show them	as many different interactions and responses

Participant	Does interaction work in this context?
1	-
2	-
3	-
4	-
5	In this context I do not want to stand out so i wouldn't use the tattoo here
6	-
7	-
8	-
9	-
10	-

Context: Party

Participant	Gender	age	has tattoos	perception of other peoples tattoos
1	Woman	25	no	Tattoos have become more common
2	man	26	no	Cool on arms or legs. Face too intense
3	Woman	24	no	Should not be too crazy. Some are pretty.
4	woman	23	no	No particular opinion. Small is nice. Some can look agressive
5	Woman	23	no	not a particular opinion
6	Man	25	no	Cool and unique. On the face is too extreme.
7	Man	27	no	Depends if it fits with the person. Then it could be cool
8	Man	26	yes	Nice, but should have a meaning
9	Woman	26	no	Something small is nice
10	Woman	24	no	If it is not on the face it is nice.

Participant	First impression of the new tattoo concept	Which Purpose	How would it look
1	Would be interested in a tattoo that you can interact with	Respresenting identity	Big and visible
2	Very cool, if it is not too expensive	identity	Big, draws attention
3	Sounds futuristic. Interesting if not permanent.	connectivity	Theme of party
4	Sounds cool, especially when temporary	identity	abstract, bright
5	nice if it is temporary	identity	Drawing attention, but thin lines
6	Sounds cool, but difficult. Something I cannot take off like a festival bracelet i dont like.	emotions	simple and a lot of light
7	Yes if you can customize the design it could be cool	identity	bright, theme depends on party
8	Would like to try it and see how it works	emotions	depends on user
9	Interesting and cool that it is something that does not exist yet.	identity	big and drawing attention
10	thinks it is interesting	identity	abstract shapes, lots of light

Context: Party

Participant	Where on the body	Size	Who wears it	Who interacts with it
1	Arms. (cool if everyone raises arms)	big	Everyone	Yourself (not preferred if everyone touches you at a party)
2	under arm	big	1 or a few people	Both, but you decide
3	Shoulder/upper arm	medium	everyone (when you enter	everyone
4	underarm	small or medium	everyone (when you enter	everyone
5	arm/shoulders, maybe face	big	multiple/everyone	everyone
6	hand	big	everyone (when you enter	everyone
7	under arm/hand	big	everyone (when you enter	yourself
8	arm	medium	yourself or a few	yourself
9	face/arm	big	everyone	everyone
10	arms	big	everyone	everyone

Participant	Which interaction types and movements	Does interaction work in this context?
1	Tap to turn on and off	Maybe a party is not the best place to use this tattoo.
2	pulse to draw attention. Something else after tap	-
3	tap. something bright like pulse	-
4	pulse on beat, through tap.	-
5	Tap turns on flashing/pulsating	-
6	tap turns on the tattoo (light)	-
7	tap to make something random light up	-
8	slide to turn parts on	-
9	simple tap to turn on pulsating effect	-
10	pulsating effect when tapped	-

Appendix E

Tutorial on creating your own mesh

The whole process of making a stencil on the mesh was performed at the open studio at the TU Delft. The open studio has access to all needed materials and tools, such as uv emulsion and a UV lamp. This guide will go through the process of producing a graphic on a mesh at the open studio, using the materials and setup provided there. Throughout the guide some handy insights are given which are beneficial to know up front.

What is needed

1 Clear mesh (zeefdruksupply.nl)

2 Dry, dark room (available at open studio)

3 UV lamp (available at open studio)

4 Glass plate (available at open studio)

5 Transparent film (available at open studio)

6 Graphic software (for example Adobe illustrator)

7 Scraper (available at open studio, but check for the right size)

8 UV emulsion (available at open studio)

9 Solvent (available at open studio)

10 Water and sponge (available at open studio)

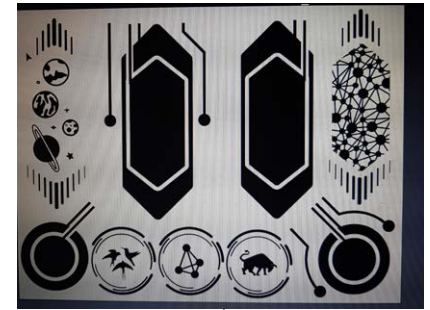11 High pressure water beam (available at open studio)
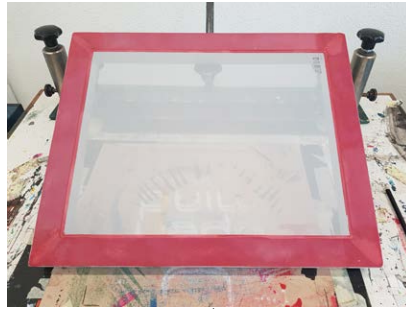
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1 Make graphic

Use graphic software to produce a graphic in black and white. The minimum graphic line thickness should be around 1 mm.

2 Print graphic

Use transparent film to print the graphic. You can use a TU printer and select the manual input to print on the transparent film. Do this twice and stick these two sheets together to ensure blockage of the UV light.

3 Apply emulsion on mesh

Place the mesh in a stable position against a wall and in a dark place, allowing pressure to be applied to the mesh without the mesh moving. Apply enough emulsion into the scraper and place the scraper on the bottom of the mesh. Wait until the emulsion is touching the mesh over the whole length of the scraper and apply the emulsion on the mesh with one pressurized movement upwards. Tilt the scraper and wait until the leftover emulsion flows back into the scraper before removing it from the mesh. All this should be done in a dark place. It should be noted that the scraper should be slightly smaller than the frame of your mesh. If it is bigger, the pressure you apply will be on the frame, instead of the mesh which results in a layer of emulsion that is too thick.

4 Dry emulsion

Whilst being in a dark place, let the emulsion on the mesh dry. Using a heater, this should take between 5 and 7 minutes. Test with your finger in the corner of your mesh whether it is dry.

5 Move the mesh

Quickly move the mesh from the drying room to the room with uv light. This should be done relatively fast, to prevent curing of the emulsion. The room with the uv light should also be kept as dark as possible during the following steps.

6 Cure emulsion using UV lamp

Place your graphic on the glass plate in the room with the UV lamp. Place your dried mesh on top of your graphic as how you want your graphic to be created on your mesh. There is a wire lying on the glass, place this over your mesh. No close the top of the glass plate and secure it. Turn on the vacuum suction and wait for at least 1 minute. Turn the glass 90 degrees and make your graphic face the UV-light. Now turn on the uv lamp and let the emulsion cure for three minutes. The lamp at the open studio which was used has a fixed distance to the glass of 1.60 meters and a power of 3,68 KW.

7 Move mesh

After three minutes you turn off the lamp. You can turn the glass back to horizontal. Turn off the vacuum and open the lit. You can now take out the mesh. You should be able to see a color difference between the parts that are cured and the parts that are not. Now take your mesh to the cleaning room. From here it is oke to expose your mesh to daylight.

8 Use water to clean emulsion off

Use water and a sponge to clean the parts of the mesh that were initially covered with the black parts from the graphic. Whilst brushing, the emulsion will start to come of at some places. Continue brushing with the sponge untill the graphic is completely cleaned off.

9 After usage of mesh, Use solvent to clean mesh (Only execute this step if you want to remove the graphic from your mesh)

When you want to remove the graphic from the mesh, you can use a solvent and a high pressure water beam. Apply the solvent with a brush and cover the whole mesh with it. Then wait for 5 minutes. Now the emulsion can be removed when a high pressure water beam is used on the mesh. It might be a bit difficult at first, but by keeping the water beam really close to the mesh, parts should start to come off. A side note here is that the dried emulsion should not have been there for longer than a few weeks. After that it will become more difficult to completely clean a mesh.
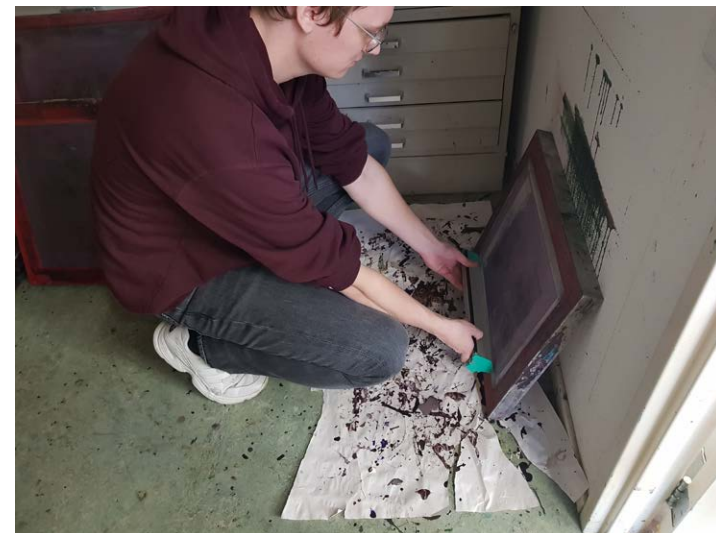
* In this instruction guide photo's were used from two different sessions, thus resulting in different graphics. Nonetheless the process is identical in both.
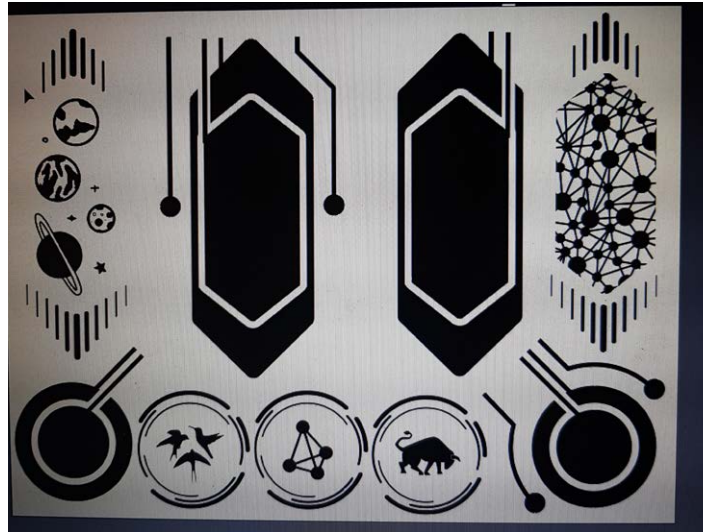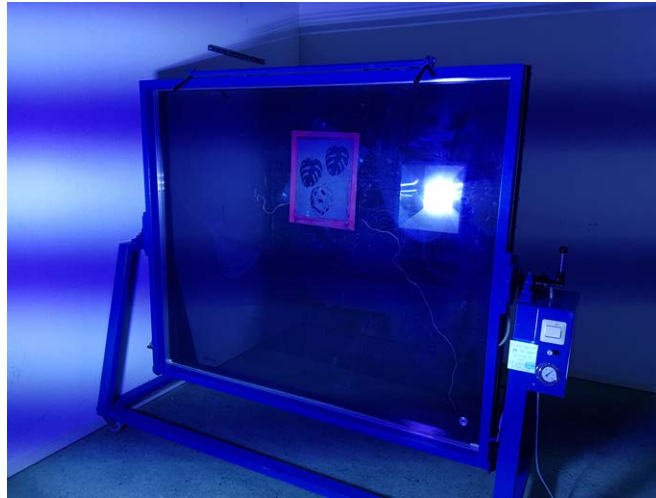

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Result after creating a
mesh (excluding step 9)

Appendix F

The arduino code used to create the prototype

```cpp
#include <CapacitiveSensor.h>
CapacitiveSensor cs_4_2 = CapacitiveSensor(4,2);
// 10M resistor between pins 4 & 2, pin 2 is sensor pin

//luminescent areas to light up, works as switch
const int lumnsw1 = 6; //faded area, and lighted up constantly at the end
const int lumnsw2 = 8; //constantly lighted up

void setup() {
cs_4_2.set_CS_AutocaL_Millis(0xFFFFFFFF);
// turn off autocalibrate on channel 1
Serial.begin(9600);
pinMode(6, OUTPUT);
pinMode(8, OUTPUT);
}

void loop() {
  analogWrite(8,0); //keep the lumn 2 area off
  Serial.print("Entering lighting up\n");
  //lighting up
  for (int level = 2; level < 200; level++){
    analogWrite(6,level);
    delay(8);
    if (level % 10 == 0) //lets check for a touch every 0.1 secs
    {
      long total1 = cs_4_2.capacitiveSensor(30);
      Serial.print(total1); // print sensor output
      Serial.print("\n");
      if(total1 > 4000) //sensing threshold
      {
        Serial.print("sense received, light up lumn 1 and 2\n");
        analogWrite(6,225);
        analogWrite(8,225);
        delay(10000); //wait for 10 sec
        break;
      }
    }
  } //end of lighting up
  Serial.print("Entering fading low\n");

  //fading
  analogWrite(8,0); //keep the lumn 2 area off

  for (int level = 200; level > 2; level--){
    analogWrite(6,level);
    delay(10);
    if (level % 10 == 0) //lets check for a touch every 0.1 secs
    {
      long total1 = cs_4_2.capacitiveSensor(30);
      Serial.print(total1); // print sensor output
      Serial.print("\n");
      if(total1 > 4000) //sensing threshold
      {
        Serial.print("sense received, light up lumn 1 and 2\n");
        analogWrite(6,225);
        analogWrite(8,225);
        delay(10000); //wait for 10 sec
        break;
      }
    }
  } //end of fading
} //end of void loop()
```